1) Chart: Final Regression Models
a) What is the definition of income. I.e. is it dollars, 1000 dollars or otherwise?

Variable is annual household income, and it is in categories as coded in the 2001 SCAG regional household travel survey:

1	Less than $10,000
2	$10,000 to $24,999
3	$25,000 to $34,999
4	$35,000 to $49,999
5	$50,000 to $74,999
6	$75,000 to $99,999
7	$100,000 to $149,999
8	$150,000 or more

b) Explain and/or provide equation for regional transit access.

This is the so-called "gravity" model formulation of accessibility, calculated through the following expression:

$$Accessibility_i = \sum_j \frac{Jobs_j}{Travel\,Time_{ij}}$$

It basically identifies the attractions available in each regional traffic analysis zone (TAZ_j) to a person in a given TAZ_i, discounted by the respective zone-to-zone travel impedance. The value of accessibility is the sum of these discounted attractions over all potential TAZ destinations. Obviously, jobs located in TAZs where there is no access by transit from the origin TAZ would not be "accessible," and hence would not be included in the total. In this instance, attractions are represented by total jobs and impedance is represented by transit travel time, including all elements of in-vehicle, wait, transfer, and access/egress time (travel cost is not included in our measure). Peak hour transit service and travel times are used for our measure, although an off-peak service measure was also developed and tested.

c) How do you calculate LU mix. I understand it is a value between 0 and 1 but what is the equation for it?

Land Use Mix is our terminology for "Entropy", which is a common measure of "dissimilarity" (one of the 3Ds) in models of land use. It measures both the number of different land uses in a given area of analysis, as well as the "balance" of those uses in terms of their relative proportions. The equation used for its calculation is:

$$Entropy = -\sum_j \frac{(P_j \times \ln(P_j))}{\ln(J)}$$

Where P_j = proportion of land in the J*th* use type And ln is the natural log

The index varies from 0 to 1, with 1 denoting ideal balance, which occurs when all distinct land use types occur in equal proportions within a tract

In our application, entropy quantifies the mix and balance of land use within a 1/4 mile radius of the households in our 2001 HTS travel survey sample. Using GIS in conjunction with SCAG's detailed land use database, it was possible to determine the actual proportions by overlaying the 1/4-mile walkshed over the parcel-based land use layer and determine the actual land use proportions in play (normally it is necessary to first impose a grid-cell raster layer and designate a "predominate" land use to each grid cell -- this data allowed for a much more accurate parcel-level calculation).

d) I assume LN refers to the natural log. Is this right?

It is the natural log

e) How do you calculate walk opportunities?

Also through the power of GIS, it was possible to identify all of the types of opportunities that might be available and of interest to a household within its 1/4 mile walkshed. This was done using a 2001 Dunn & Bradstreet database which not only designates the exact x,y geographic location of each opportunity, but its characteristic by 4-digit SIC (standard industrial code). The relevant "opportunities" include primarily retail and service establishments, covering the range of grocery stores to gas stations to doctor's offices and hospitals, schools and colleges, restaurants, movies and video rentals, sports arenas, museums, parks, swimming pools, fire stations, etc. Because households are likely to find considerably more value in having some of these activities in close proximity, it is desirable to place a value "weight" on each activity. While this is not a well studied topic, we were fortunate to find a 1980's study done in Los Angeles by researchers at the University of Virginia that extensively surveyed neighborhoods in Los Angeles and developed a system of priority weights from their findings. These weights range from +1 to -1, with the former being most desirable (grocery store registers above 0.8 while a bar/nightclub registers around -0.7).

Knowing the type and location of each activity in the household's walkshed, GIS was then used to overlay the street grid, thus making it possible to build walk paths from the household to each activity. Similar to regional transit accessibility, we then summed up all opportunities (represented by their individual weights) and discounted their value by a function of the walk time to reach them.

The following equation was used to calculate the measure:

$$\text{Walk Opportunities}_h = \Sigma_i \frac{O_i \times W_i}{D_{hi}}$$

Where:

O_i = Opportunity within 1/4 mile of Household *h*
W_i = Importance Weight for Opportunity *i*
D_i = Distance from Household *h* to Opportunity *i*

Because the measure thus formed was found to have a very non-linear distribution across the population (many households in the region had very low scores while increasingly few had high scores), a natural log transform of this variable was used in the regression models.

f) How does walk opportunity compare to a walk trip? For example, you may have an opportunity to walk to the butcher but you would rather buy elsewhere and your trip to the butcher is actually driven.

What it does is reflect the degree of attraction that exists locally, which in many cases in the LA region, is currently very poor. It allows that households in any setting -- regardless how ideally mixed and urban -- will likely still own cars and still periodically choose to drive, even within their walkshed. However, statistically what this variable does in the auto ownership and VMT models is say that, as local mix and walkability gets richer, households will own fewer vehicles and will make a higher proportion of trips for these kinds of activities locally, either by walking, local transit, or shorter auto trips.

g) How and from where do you calculate HBW VMT?

For most of these questions, it is necessary to distinguish between the source of information for creating the variables when developing the regression equations vs. where it will be obtained/constructed in the subsequent application and forecasting step. Individual household travel survey and locational data were used in estimating the models, though more aggregated data from the regional travel model or other sources will be used in the forecasting. All VMT measures as derived from the HTS is defined as "vehicle miles driven by a household member". Trips are coded into 6 purposes, one of

which is Home-Based Work, HBW. Note that in most cases, a household "work" trip is not merely home-to-work-to-home, but involves intermediate stops; attempts to account for this with the trip-purpose coding protocols address some of the concerns with these variations but also raise others. Hence, there is some unavoidable "noise" in the HBW measure of commute travel and VMT.

h) Is not HBW VMT affected by the type LU Mix for example?

Surprisingly little, and numerous research studies can be referred to which support the point. Generally what they find is that most people are not fortunate enough to work close to home, or even to position themselves such that both their residence AND job location are within easy access of transit. For those people who do have these ideal conditions, the existing travel models do a fair job of picking up the effect of their traveling by transit or NOT driving. However, because of intervening factors like job changes, employer relocation, or spouse working in an entirely different location, it is difficult to posit a strong connection between local land use and travel behavior for the work trip.

i) How can the factor before LN HBW VMT be 0.532? If all other factors were zero then you would be left with LN HH VMT = 0.532 LN HBW VMT. This is obviously not right. The factor should be 1.0.

I believe it is because of the log format. In the unlogged version of the model, the value of the coefficient was essentially 1.0.

2) CHART: Look-Up Table Default Values
a) Define and explain WtdOpp.

This is the Walk Opportunities variable, as discussed above in (e). It is sometimes labeled WtdOpp because of the value weight attached to the opportunity.

b) Define and explain %Red

Percent reduction (% Red) is the change in household VMT rate that would occur in response to the default values assigned two the two local land use variables (LU Mix and WtdOpps) in the table. All other variables in the auto ownership and VMT models were held constant and the equations used to calculate the resultant total VMT. The percent is the difference between the calculated value and the value of Total VMT if the sample means were used for all variables. In this illustration, HH VMT for the average household would be 49.13

per day, whereas the value of 43.79 for the Downtown Center would reflect a 10.9% reduction in VMT production over the average.

c) In the columns, Resid, Empl, Ret/Svs, I assume you are measuring percentage number of people in each category. But if TOD and Center strategies work then people live and work in the same area. If that were so then the numbers should add up to more than 100%. So how is that accounted for?

Actually, no, it is not people. It is the percentage of land in the respective use type. This is how the Blueprint land use categories were defined, as "composites", and we have had to find a way to work with them.

3) Finally, I missed a meeting where the term 4D was defined. Can you define it? Are you just referring to the 4-step regional model?

No, and the use of the number 4 in both cases is regrettable! The 4Ds are the standard convention for referring to the land use attributes of Density, Diversity and Design. The 4th D is Regional Accessibility, which isn't a D but has an important supporting role in explaining auto ownership and dependency.